TECHNICAL ASSESSMENT MEMO

REGULATION 8, RULE 7
GASOLINE DISPENSING FACILITIES

TABLE OF CONTENTS

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INTRODUCTION

The 1997 Bay Area Clean Air Plan (CAP) included Control Measure B8, Emission Reductions From Gasoline Dispensing Facilities (GDFs). This control measure was expanded from an previous version in the 1994 CAP. It proposes to further reduce emissions of volatile organic compounds (VOCs) from GDFs by requiring minor modifications to several existing vapor recovery systems and prohibiting new installations of vapor recovery systems are not compatible with Onboard Refueling Vapor Recovery (ORVR) equipped vehicles. In addition, since the development of Control Measure B8 staff has identified several additional strategies to improve vapor recovery at both new and existing installations. Other proposed revisions would clarify the applicability and intent of Regulation 8, Rule 7 and otherwise enhance the effectiveness of the vapor recovery program.

BACKGROUND

There are slightly less than 2,600 gasoline dispensing facilities (GDFs) in the District. Of these, approximately 1,600 are retail facilities that sell fuel directly to the general public. The balance are non-retail stations located at a wide variety of facilities such as industrial plants, airports, car rental agencies, and other businesses which operate fleets of vehicles or mobile equipment which need to be refueled on-site. Although some non-retail locations have large throughputs, retail stations dispense the overwhelming majority of gasoline in the District and are the primary source of emissions from this source category.

Gasoline is a highly volatile organic liquid with a Reid vapor pressure (RVP) varying from 7.0 psi to 11.0 psi according to seasonal requirements. As such, there is a large potential for emissions of volatile organic compounds (VOCs) whenever gasoline is stored, loaded, or handled. GDFs are one of the major potential sources of VOC emissions in the Bay Area. In absence of any controls whatsoever on GDFs, VOC emissions from this category would be approximately 73 tons/day.

The BAAQMD regulates gasoline dispensing operations in the District under Regulation 8, Rule 7. Over the years Reg. 8-7 has been modified and its applicability expanded to the point where almost all GDFs are subject to some control requirements. Reg. 8-7 also sets standards for both the operation and maintenance of vapor recovery systems and general housekeeping requirements that apply to all stations.

The primary technique for controlling emissions from GDFs is vapor recovery. Vapor recovery systems collect and contain vapors generated during the handling of volatile organic liquids that would otherwise be emitted to the atmosphere. Vapor recovery equipment for GDFs falls into two categories: Phase I and Phase II. Phase I vapor recovery captures vapors generated when gasoline is transferred from a tanker truck (aka cargo tank) into a stationary storage tank. Phase II vapor recovery collects vapors when vehicles are being refueled.

The California Air Resources Board (CARB), under Health & Safety Code Section 41954, has sole authority for certifying vapor recovery systems and their components for use in California. Equipment vendors submit their systems to CARB for testing. Passing systems are issued an Executive Order, which sets specifications for the installation and operation of the system and lists allowable components and configurations. There are currently more than 80 Executive Orders in force for Phase I and Phase II systems. Reg. 8-7 requires that all vapor recovery systems, components, and configurations be CARB certified. Because of CARB's leadership role in the field, many jurisdictions outside California also allow only the installation of vapor recovery systems and components certified by CARB.

Over 97% of the GDFs in the District (about 2,500 stations) are required to have Phase I vapor recovery. Almost all of the stations with Phase I are also required to have Phase II recovery. Reg. 8-7 includes several exemptions from Phase I and Phase II requirements based on size limitations and technical considerations. Most GDFs exempt from vapor recovery requirements are small, non-retail facilities with low throughputs that service a limited fleet of vehicles. Many refuel vehicles such as boats or aircraft for which Phase II vapor recovery is not effective.

The District first required Phase II vapor recovery in 1973. It was the first jurisdiction in the country to implement Phase II. In 1976, CARB superceded the authority of local districts to directly specify vapor recovery systems and components by introducing state-wide certifications. Under the California Health and Safety Code, CARB now has ultimate authority over most aspects of the vapor recovery program, including the sole responsibility for certifying the vapor recovery systems that may be installed in California (H&SC Section 41954). Local districts cannot mandate the installation of vapor recovery equipment unless it has been certified by CARB.

Reg. 8-7 functions primarily as the District's implementation of state law. It has been revised numerous times over the years in response to changes in legal requirements and advances in vapor recovery technology. The rule was last amended in June 1994.

Since the 1994 revisions, there have been several major changes in the gasoline dispensing industry. State mandated reformulated gasoline (RFG) was introduced in 1996, resulting in a major reduction in the toxic compounds (primarily benzene) emitted from GDFs. CARB has certified several new Phase II vapor recovery systems and revised many of the orders covering existing systems. Water quality regulations placing strict new standards on underground storage tanks became effective on December 22, 1998. Many stations, since they were replacing their underground tanks anyway, took this opportunity to completely rebuild and modernize their facilities. Many non-retail GDFs elected to replace their underground tanks with aboveground tanks.

Most significantly, vehicles equipped with on-board refueling vapor recovery (ORVR) began to be sold in the 1998 model year. ORVR is a vehicle-based system to recover and utilize vapors generated during refueling. Phase II controls are superfluous when an ORVR-equipped vehicle is refueled. When a sufficiently high percentage of the vehicle fleet is equipped with ORVR, Phase II controls will no longer be necessary.

Many of these changes, most notably the introduction of RFG, have been beneficial to air quality. However, others have been detrimental and in some cases have caused emissions to increase above previous levels. The most severe problem identified to date is associated with the introduction of a new generation of vacuum assist Phase II vapor recovery systems. Several of these systems have shown a significant propensity to operate in the field at vapor recovery efficiencies below the 95% required by the Executive Order. District testing programs have found as many as 50% of the nozzles at these stations fail to meet other performance standards specified in the applicable Executive Order.

Furthermore, most of the new vacuum assist systems have not yet demonstrated compatibility with ORVR-equipped vehicles. There is a potential for a station equipped with some Phase II vapor recovery systems to emit more VOCs than when refueling a fleet containing a high percentage of ORVR-equipped vehicles than a comparable station without Phase II vapor recovery whatsoever.

PROCESS DESCRIPTION

GDF vapor recovery technology is traditionally divided into two systems: Phase I and Phase II. Phase I vapor recovery controls emissions during the loading of the GDF storage tanks from tanker trucks (aka cargo tanks). Prior to filling the tank (the "drop"), a vapor hose is connected between the stationary tank and the cargo tank. As the gasoline level in the tank rises, the gasoline vapors generated in the tank headspace are displaced by the rising level of liquid gasoline and forced back through the vapor hose to the headspace of the cargo tank. The cargo tank later transports them off-site. The vapors will be recovered via another vapor recovery system at the bulk plant or terminal when the cargo tank is refilled. Virtually all tanks are also required to have a submerged fill tube to minimize vapor generation during the drop.

CARB has certified two basic types of Phase I systems: coaxial and two-point. A coaxial system utilizes a single coaxial pipe equipped with separate concentric passages for product and vapors. Product is delivered through the inner pipe while vapors are returned to the vapor line through the outer passage. Two-point systems use separate pipes for product delivery and vapor recovery. Two-point systems have been demonstrated to be more reliable and effective than coaxial systems. Most newer stations are equipped with two-point Phase I systems; some new Phase II recovery systems may only be used in conjunction with a two-point Phase I system.

Phase II vapor recovery systems collect vapors generated during the refueling of vehicle tanks. A special vapor recovery nozzle captures the vapors during fuel dispensing. The collected vapors pass through a vapor passage in the nozzle back to the hose and then through vapor piping leading to the headspace of the fuel storage tank.

The most commonly seen Phase II system is the balance system. Balance nozzles are equipped with bellows that must be firmly compressed to maintain a tight seal between the nozzle face plate and the vehicle fill tube. During refueling, the pressure from the rising liquid level in the vehicle fuel tank combines with a slight vacuum created by the dropping liquid level in the stationary tank to force the gasoline vapors into the nozzle bellows and through the nozzle vapor path and hose and into the vapor piping, eventually returning to the storage tank headspace. Maintaining a tight seal at the nozzle/fill pipe interface is crucial for capturing the vapors during refueling.

To ensure a proper seal, most balance nozzles are equipped with an "insertion interlock" which will not allow the dispenser to activate and refueling to commence unless the nozzle is properly inserted. The insertion interlock requires the nozzle to be thrust into the fill pipe with enough force to compress the bellows and guarantee a tight seal between the face plate and the fill pipe. Although improved designs have made balance systems significantly easier to use since their introduction during the 1970s, there remains considerable incentive for the development of a nozzle that combines effective vapor recovery with the ease-of-use of conventional (non Phase II) nozzles.

This has been the impetuous for the development of assist type Phase II systems. These systems typically use pumps or similar equipment to generate a vacuum at the nozzle/fill pipe interface during dispensing. This negative pressure captures the gasoline vapors, which are then returned via the usual vapor hose and piping to the storage tank headspace. CARB has certified numerous systems based on variations of this principle over the years.

Vacuum assist nozzles are significantly different from balance nozzles. As a tight seal at the nozzle/fill pipe interface isn't needed for effective vapor recovery, vacuum assist nozzles require neither insertion interlocks or bellows. Not only is it unnecessary, it can be hazardous. A tight seal could potentially cause damagingly high vacuum in the vehicle fuel tank. Assist nozzles are designed either with no bellows at all or with loose-fitting facecones to enhance vapor collection. Because they do not need to be forcibly inserted into the fill pipe, they approach conventional nozzles in ease of use.

Designing an effective, reliable, and economical vacuum assist system presents a considerable technical challenge. Vacuum levels must be carefully controlled; too little vacuum will fail to achieve satisfactory vapor recovery, too much vacuum can collect excess air and cause elevated pressures in the storage tank. Because of the higher vacuum and pressure levels in the system, leaks are a much greater concern than balance systems. Increased pressure in the storage tank increases the rate of fugitive emissions from leaks in the vapor recovery system ("pressure related fugitives"). If the pressure becomes high enough to exceed the cracking pressure on the tank vent PV valve, gasoline vapors will be released from the vent.

One solution to some of these problems is to use a high vacuum to ensure good vapor recovery in conjunction with a "vapor processor" (generally a small afterburner) to abate vapors bled off from the tank when pressure in the headspace exceeds a preset level. Although technically sound, these systems have yet to achieve widespread acceptance. For economic reasons, the control unit generally is not fired continuously, but operates intermittently on an "as needed" basis. This requires a fairly sophisticated system of automatic controls to monitor the system pressure, ignite the processor and vent the tank headspace at the proper time. There is concern that the normal day-to-day staff at many GDFs, especially self-service stations, lack the technical expertise to properly maintain and operate these systems.

Another solution is to carefully control the vacuum level, keeping the ratio of vapors collected to fuel dispensed (air-to-liquid ratio, or A/L) at approximately 1:1 to prevent the tank from being over-pressurized. This eliminates the need for a vapor processor and its attendant control system and makes for a simpler system that is easier to maintain and operate. However, these systems have not been without their own problems. There have been difficulties in the field with maintaining the A/L ratio within the proper range, and problems with excessive leaks and vapor line blockage have been common.

Assist-type systems remained comparatively uncommon in the District until the mid-1990s, when CARB certified a new generation of vacuum assist systems that found widespread acceptance throughout the industry. Almost 40% of the retail stations in the District, including most stations affiliated with major oil companies (both company-owned and franchised-stations) have converted to some form of assist Phase II vapor recovery. CARB estimates that vacuum assist equipped stations currently dispense 55% of the gasoline sold in California.

The most commonly seen assist systems in the District currently are vacuum assist systems such as the Gilbarco VaporVac and the Dresser Wayne WayneVac. These systems utilize dispensers equipped with individual vapor pumps. When gasoline is dispensed, the vapor pump in the dispenser is activated. This creates a vacuum which draws gasoline vapors into the nozzle through several vapor holes in the nozzle spout. Vapors pass through a vapor passage in the nozzle and thence via the coaxial hose and vapor piping to the storage tank headspace. Neither systems uses a vapor processor.

The recent introduction of onboard refueling vapor recovery (ORVR) to the vehicle fleet will eventually render Phase II vapor recovery obsolete. ORVR is a requirement of the 1990 Clean Air Act Amendments. After some litigation, EPA promulgated an ORVR rule in 1994 calling for a phase in of ORVR controls beginning with the 1998 model year. All new autos will be required to have ORVR starting with the 2000 model year. ORVR requirements will be expanded to include all light-duty trucks by the 2003 model year.

ORVR is a vehicle-mounted system to recover and destroy the gasoline vapors generated during refueling. In an ORVR-equipped vehicle, a seal in the fill neck typically either mechanical or liquid, prevents gasoline vapors from escaping through the fill neck during refueling. Instead, the displaced vapors in the vehicle tank headspace are vented to a small activated carbon canister mounted in the vehicle. The canister is automatically desorbed during normal vehicle operation, with the desorbed gasoline vapors routed to the intake manifold and combusted in the engine during normal driving. The use of ORVR renders Phase II controls superfluous. ORVR systems can achieve high vapor recovery even when conventional (non-Phase II) nozzles are used.

The difficulty arises when an ORVR-equipped vehicle refuels at a station equipped with assist-type Phase II vapor recovery. By design, assist systems are "active." Most systems automatically generate a vacuum to recover vapors whenever fuel is dispensed. However, when an ORVR-equipped vehicle is refueled, the ORVR system captures essentially all the vapors. There is no significant quantity of gasoline vapors available for recovery at the nozzle/fill pipe interface. As a result, most vacuum assist systems will collect ambient air in lieu of gasoline vapors and return it to the storage tank. The ingestion of unsaturated air into the storage tanks dilutes the concentration of gasoline vapors in the tank headspace and can lead to "vapor growth."

Vapor growth can occur whenever the concentration of gasoline vapors in the tank headspace decreases below the saturation level. This creates a driving force for liquid gasoline to evaporate to re-establish the liquid/saturated vapor equilibrium. As gasoline-saturated air takes up a volume approximately 30% greater than unsaturated air, pressure inside the tank increases as the liquid gasoline evaporates.

When enough gasoline evaporates, tank headspace pressure can exceed the cracking pressure of the pressure/vacuum-valve on the vents (generally 3" water column), allowing the release of possibly large quantities of gasoline vapors from the tank vent. These emissions partially offset the emission reduction achieved by the ORVR system. For a station refueling a large percentage of ORVR-equipped vehicles, the vent pipe emissions may be sufficiently large that a net air-quality benefit could be realized by disconnecting the Phase II system.

Even if the PV valve remains closed, elevated tank pressures can increase the amount of "pressure related fugitives" from the station. Vapor recovery systems are complicated, incorporating extended piping runs and numerous valves, fittings, and other assorted components, many of which are susceptible to leaks. Even at well-maintained stations, vapor recovery systems are not 100% gas-tight. CARB recognizes and certifies some components (such as nozzles) with an allowable leak rate. One of the basic compliance tests, the pressure decay test, allows for a slight amount of overall leakage from the system. Leakage is inevitable at any station. However, systems that routinely operate at high tank pressures will have higher rates of fugitive emissions from these leaks.

Of all the assist-type systems certified for use in California, only the Healy 400 ORVR vacuum assist system has been certified as compatible with ORVR. The Healy 400 ORVR nozzle is equipped with a floating orifice. If no vapors are being removed from the vehicle tank, a plate closes the vapor path, preventing air ingestion to the stationary storage tank. Other manufacturers of vacuum assist systems are investigating potential solutions.

Balance-type Phase II systems are also expected to be compatible with ORVR. Balance systems are "passive"; vapor recovery only occurs when the rising fuel level in the vehicle tank forces the gasoline vapors out the fill pipe and into the nozzle bellows. In the case of a vehicle equipped with ORVR, this does not occur. There is no driving force causing ambient air to be ingested into the tanks. A GDF equipped with a balance system should be able to refuel both

ORVR and non-ORVR vehicles with no significant change in vapor recovery efficiency or in the amount of pressure-related fugitives. CARB is currently investigating the compatibility of balance systems with ORVR vehicles.

A small portion of gasoline in the Bay Area is dispensed by mobile refuelers. A mobile refueler is a cargo tank equipped with a nozzle which allows it to directly refuel vehicle tanks. The cargo tank is filled at a stationary tank and then drives to the vehicle to be refueled. These operations are common at airports and at facilities which operate large fleets of vehicles where it is more convenient to refuel the vehicles in place than to drive them to a stationary dispenser. Currently, no mobile refuelers are equipped with Phase II controls. However, many are already operating Phase I recovery on both the stationary tank and the cargo tank.

CONTROL STRATEGIES

The basic control strategies proposed in these amendments fall into the following three categories:

- **Restore effectiveness of the vapor recovery program:** Several certified vapor recovery system components have demonstrated significant potential to operate at vapor recovery efficiency below levels mandated in the current regulation. Under the proposed revisions, new installations of these components would be prohibited. For some components, further operation at existing installations will not be allowed after June 1, 2000. They must be replaced with complying components before that time.
- **Prevent future emission increases**: This is proposed to be accomplished by requiring all new vapor recovery equipment to be certified to more rigid (albeit equivalent) standards and prohibiting new installations of vapor recovery equipment not compatible with ORVR.
- **Extend emissions control requirements**: A small amount of additional emission reductions can be achieved by expanding the applicability of Phase I vapor recovery and pressure vacuum (PV) valve requirements to previously unregulated fueling operations. These requirements would also enhance the effectiveness of ORVR. No extension of Phase II requirements is being proposed at this time, although some of the amendments will clarify the applicability of the Phase II exemptions.

More Rigid Equipment Certifications

Under Health & Safety Code Section 41954, CARB has the exclusive authority to certify Phase I and Phase II vapor recovery equipment used in California. Phase I and Phase II vapor recovery systems are submitted by their manufacturers to CARB for evaluation and testing. Only CARB-certified vapor recovery equipment may be used in California. Local districts may not independently certify or require the use of non-certified equipment.

The certification testing process is detailed in CARB's Vapor Recovery Certification Procedure CP201. The procedure establishes strict testing protocols and requires a system to achieve a minimum of 90% vapor recovery to be certified. However, applicants may request their systems be certified to a higher efficiency if desired to meet the requirements of local districts.

Most air districts in California (including the BAAQMD) currently require both Phase I and Phase II systems to be CARB-certified as achieving 95% vapor recovery. In lieu of this, staff is proposing that vapor recovery systems be certified to the following standards:

- **Phase I: 98% vapor recovery** *(proposed Section 301.10):* Extensive testing performed over the years by District staff has shown that existing two-point Phase I systems, when properly installed and operated, can easily meet this higher standard.[1] Re-certifying these systems at this higher vapor recovery efficiency will prevent the certification of future systems that would be inferior to current equipment.
- **Phase II: Certify to emission standards**: (*proposed Section 313*): Staff is proposing that new Phase II systems be certified as having emissions from the nozzle/fill pipe interface, storage tank vent pipes and pressure-related fugitives total less than 0.7 pounds per 1000 gallons of gasoline dispensed; that spillage emissions not exceed 0.42 pounds per 1000 gallons of gasoline dispensed; and that pseudo-spillage emissions not exceed 0.42 pounds per 1000 gallons of gasoline dispensed. The first two figures are equivalent to 95% emission reduction based on the current emission factors for unabated GDFs.

  These are, as such, essentially equivalent to the existing standards. However, Staff considers certifying to an emission level to be superior approach over certifying to a vapor recovery efficiency. Abatement efficiency standards are more appropriate for equipment utilizing traditional "tailpipe" controls (such as afterburners) where abated and unabated emissions can be measured more or less concurrently. GDFs, with their multiple sources of fugitive emissions, are more logically addressed via specific limits on the various sources of emissions. Establishing actual emission levels also makes the standards hard and fast numbers, unaffected by any changes made to the unabated emission factors. Most currently certified Phase II systems should have no difficulty being recertified to the "new" standards.

  The last item, pseudo-spillage, is a potentially significant source of emissions from GDFs that is not considered in the current CARB certification procedures. Staff feels that it is important to prevent the installation of new systems with significant pseudo-spillage emissions. The issue of pseudo-spillage is discussed more extensively below.

Both of these requirements would take effect on the later of the following dates: June 1, 2000 or six months from the date CARB certifies a second system as meeting the new standards. Under the Health & Safety Code, the District is prohibited from adopting a regulation which would grant one manufacturer a monopoly.

Hardware Improvements

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[1] 1997 BAAQMD Clean Air Plan

- **Prohibit new installations of currently certified coaxial Phase I systems** *(proposed Section 301.8):* Two point Phase I systems have been shown to be more reliable and are far less likely to leak than the currently certified coaxial systems. Staff studies have identified approximately 300 defects on coaxial systems affecting vapor recovery efficiency for every defect found on a two-point.[2]

  Because of these leaks, stations equipped with coaxial Phase I systems have a greater potential for pressure related fugitive emissions. CARB has already prohibited the use of coaxial systems on most stations equipped with vacuum assist Phase II systems because these systems frequently operate at elevated tank pressures which increase emissions from any leaks in the Phase I system.

- **Require CARB-certified anti-rotational or swivel couplers on all new Phase I installations** *(proposed Section 301.9)*: Attaching fuel or vapor lines directly to the Phase I tubes subjects them to torsional stress if the hoses rotate or twist as the driver connects them to the cargo tank. This stress can eventually loosen the fitting where the tube enters the tank and create a leak in the tank headspace. An anti-rotational coupler (which prevents the tube from rotating) or a swivel coupler (which allows the hose and coupler to rotate independently of the drop tube) protects the fitting from the torsional stresses and prevents these leaks.

- **Require insertion interlocks on all bellows-equipped nozzles** *(proposed Section 302.6):* The insertion interlock is a "no seal/no flow" device which prevents gasoline from being dispensed unless the nozzle bellows are sufficiently compressed to maintain a tight seal at the nozzle/fill pipe interface. This ensures effective vapor recovery during refueling. The insertion interlock also reduces spillage by preventing the accidental dispensing of gasoline when the nozzle is not inserted in a fill pipe. All CARB certified balance nozzles in current production are equipped with insertion interlocks. However, some older stations may still be operating nozzles without the interlock. CARB Executive Order 70-52AM grants local districts the authority to require all balance nozzles be equipped with insertion interlocks. This change will codify this requirement in District regulations.

- **Require all balance nozzles to be equipped with internal vapor check valves and prohibit remote vapor check valves** *(proposed Section 302.7):* To prevent "idle nozzle emissions" emissions, it is necessary to have some means of closing the nozzle vapor passage to prevent vapors from the storage tank from escaping through it when the nozzle is not in use. All new balance nozzles are equipped with an internal vapor check valve to seal the vapor path when fuel is not being dispensed.

  Several older models of nozzles do not have internal vapor check valves. These nozzles must be used in conjunction with remote vapor check valve located in the dispenser to close the vapor path. Although this design allows for a nozzle that is lighter and easier to handle, it is inferior to the internal check valve design from the perspective of air quality. It allows any residual vapors and liquid gasoline remaining in the hose between the nozzle and the check valve at the conclusion of the refueling event to be emitted between

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[2] Ibid.

refuelings. Remote vapor check valves reduce vapor recovery efficiency by approximately 11.3%.[3]

CARB is currently in the process of decertifying several nozzles not equipped with internal vapor check valves. Although H&SC 41954 (g)(4) allows in-place decertified equipment to continue to be operated for four years following decertification, subsection 41954 (g)(2) specifically grants local districts the authority to ban operation of nozzles not equipped with internal vapor check valves after July 1, 1998.

Remote vapor check valves are proposed to be prohibited from being used in conjunction with nozzle check valves because this configuration can cause excessive wear and premature failure of the nozzle valve and hose. It is common for liquid gasoline to be found in the vapor passage of the hose as the result either topping-off or condensation. In sunny weather, this liquid starts to evaporate. With check valves in the nozzle and dispenser, both ends of the hose are sealed and the vapors trapped. This causes the pressure in the hose to increase until the nozzle vapor valve clicks open to release the pressure. This process continues with the valve repeatedly clicking open until the liquid completely evaporates. This excessive cycling accelerates wear on the valve and shortens its service life. When the nozzle valve fails, the vapor passage of the hose is once more exposed directly to the atmosphere.

This proposal does not apply to vacuum assist Phase II systems. Most vacuum assist nozzles have internal check valves. However, some systems are only certified for use with electronically-activated remote vapor check valves in the dispenser. Nozzles with internal check valves are not certified for these systems. However, the smaller hoses used in these systems do not accumulate as much liquid gasoline as do the balance hoses, which limits the idle nozzle emissions associated with the remote valve configuration.

- **Require liquid removal devices required by CARB Executive Orders achieve a 5 ml/min removal rate** *(proposed Section 302.8):* Several dispenser hose configurations are prone to accumulating liquid gasoline in the vapor passage at the low point of the hose. This liquid can restrict or even completely block the vapor passage. These configurations are required to have a liquid removal device that sucks any accumulated liquid in the vapor passage back into the fuel line during dispensing. Most of the Executive Orders requiring liquid removal devices already call for a minimum 5 ml/min removal rate. However, some CARB documents erroneously specify a 10 ml/min rate. Codifying the 5 ml/min rate will eliminate the confusion. All existing certified liquid removal devices meet the 5 ml/min rate.

- **Prohibit operation of dual-hose nozzles** *(proposed Section 302.9)*: When Phase II vapor recovery was first introduced, most nozzles had a "dual hose" configuration: one hose delivered fuel, the other returned vapors. Although simple from a design and manufacturing perspective, this was not a very successful design. In the field, the nozzles proved to be awkward to handle and the hoses easily kinked. The entire assembly was subject to excessive customer abuse, which led to high rates of leakage. Even when the assembly is vapor tight, the smaller diameter of the vapor hose has an inherently higher back pressure that restricts vapor flow. This can reduce

[3] 1997 BAAQMD Clean Air Plan

vapor recovery by up to 5%[4] compared to a similar nozzle with a coaxial hose.

Dual hose nozzles have been almost totally replaced by nozzles using the lighter and more durable coaxial hoses. New dual hose nozzles haven't been available on the market since 1986. CARB Executive Order G-70-52AM has prohibited new installations of these nozzles on balance systems since 1991. However, some small stations in the District continue to operate dual hose nozzles installed prior to this date.

- **Require the dispenser riser connection to be either galvanized piping or gasoline-compatible flexible tubing, 1" diameter** *(proposed Section 302.10)*: The riser connection is a small piece of tubing connecting the underground vapor piping to the dispenser's internal vapor plumbing at the fuel island. It is important for this riser to be made of a material that will not develop leaks from environmental or chemical action, and that it be large enough to not create a significant back-pressure. Most Executive Orders already place similar specifications on riser connections, and complying connectors are already standard in the field. However, many older stations may have installed undersized connectors or ones made of improper materials.

- **Require new vacuum assist Phase II installations be compatible with ORVR** *(proposed Section 302.11)*: As discussed previously, there are serious concerns about the performance of many vacuum assist Phase II systems in conjunction with ORVR. Some systems may ingest substantial quantities of air when refueling vehicles equipped with ORVR. With a sufficiently high percentage of ORVR equipped vehicles in the fleet, air ingestion may cause significant amounts of tank vent emissions and increase the amount of pressure-related fugitives. Overall abatement efficiency of the Phase II system may decrease below the required 95%. In the worse case, increased vent emissions and pressure-related fugitives may offset the vapors recovered by the Phase II system during the refueling of the non-ORVR vehicles.

  Currently, only the Healy 400 ORVR Vacuum Assist system has been certified by CARB (Executive Order G-70-183) as compatible with ORVR. The Healy 400 ORVR nozzle uses a floating orifice plate that closes the nozzle vapor passage when the absence of vapors is detected. Other manufacturers of vacuum assist systems are investigating potential solutions. However, none has been certified to date.

  The wording of H&SC 41954 is vague concerning the authority of local districts to prohibit duly-certified vapor recovery systems. However, a memo from CARB's legal staff dated July 27, 1998, confirms that local Districts may prohibit the installation of certified systems provided the following criteria are met:

  - The district must have a reasonable basis to believe the certified system will not meet specifications in use;
  - The more stringent standards and/or requirements have been duly adopted by the district; and,
  - There must be at least two ARB-certified systems which can meet the more stringent standards.[5]

[4] 1997 BAAQMD Clean Air Plan

The problem of air ingestion with vapor recovery systems is widely recognized, and the results of preliminary studies[6] constitute a reasonable basis for the belief that ORVR-equipped vehicles may cause excessive emissions at vacuum assist equipped stations. Most CARB certifications for vacuum assist systems specifically state that the system has *not* been evaluated for ORVR compatibility and that fugitive emissions due to pressurized tank were not included in the calculation of the overall system efficiency.

The proposed amendment would only apply to vacuum assist systems. Balance systems are not expected to ingest significant quantities of air when refueling ORVR vehicles.

- **Establish a 5 ml limit for pseudo-spillage from a nozzle** *(proposed Section 302.12)*: Pseudo-spillage is defined as any liquid gasoline remaining in the nozzle/hose assembly on the atmospheric side of the vapor check valve after refueling is completed. This gasoline is free to evaporate, and can negate a significant amount of emission reductions achieved via vapor recovery. Neither state law, CARB certification procedures, or Reg. 8-7 currently have any standards that apply explicitly to this emission source.

  Some pseudo-spillage is the result of topping off and is a violation of Section 8-7-303. However, certain models of vacuum assist nozzles have shown a tendency to retain significant fuel even after a proper refueling event. Staff has developed a test procedure to quantify pseudo-spillage, and has measured pseudo-spillage of over 30 ml from a single nozzle.

  Evaporation of 5 ml of gasoline as the result of a 10 gallon fueling is roughly equivalent to a 5% decrease in vapor recovery efficiency. Allowing nozzles to operate with pseudo-spillage above this level is equivalent to allowing a system to operate at below 95% recovery efficiency.

- **Establish a 5 ml limit for spitting from a nozzle** *(proposed Section 302.13)***:** Spitting is the release of liquid gasoline from a nozzle when the trigger is depressed without the dispenser being activated. This indicates that gasoline is seeping past the main fuel poppet into the nozzle vapor passage where it can evaporate. Staff has measured over 60 ml of gasoline released from a single nozzle in this fashion. Although a precise cause has not been determined, it is suspected that spitting may be due to a safety feature in certain models of vacuum assist nozzles.

  As with pseudo spillage, spitting five milliliters of gasoline in conjunction with a 10 gallon fueling is roughly equivalent to a 5% decrease in vapor recovery efficiency. Spitting in excess of this level is indicative of vapor recovery below 95%.

Extended Emission Control Requirements

- **Require a pressure vacuum (PV) valve on the vents of all underground** *(proposed Section 315)* **and all aboveground storage tanks** *(proposed Section 316):* PV valves are a simple way to minimize emissions from the tank vent pipe by sealing the tank headspace from the atmosphere. A PV

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[5] Krinsk, Leslie "District Authority to Regulate Gasoline Vapor Recovery Systems" memo to James Morgester, July 27, 1998

[6] Preliminary Draft, CARB ORVR simulation study

valve prevents the release of gasoline vapors except when necessary for safety reasons. A properly installed PV valve should virtually eliminate emissions from tank breathing and enhance the effectiveness of ORVR by limiting air ingestion and vapor growth. The proposal will extend the PV valve requirement to previously exempt tanks. The proposal will also revise the pressure settings currently specified in 8-7 to be consistent with CARB requirements.

- **Require Phase I vapor recovery on mobile refuelers** *(revised Section 301.1)*: The regulatory status of mobile refuelers has been a source of great confusion over the years. Mobile refueling is a hybrid operation, showing characteristics of both a bulk plant (transfer of fuel from a stationary tank to a cargo tank) and a GDF (refueling vehicle tanks). However, neither the District's bulk plant regulation (Reg. 8-33) nor Reg. 8-7 clearly address this operation. As a result mobile refuelers have been allowed to operate virtually unregulated and, in many cases without permits.

  The proposed revision will make it explicit that mobile refueling operations are subject to Reg. 8-7. They will be required to install PV valves on their storage tanks, operate Phase I controls on both the cargo tank → stationary tank and stationary tank → mobile refueler transfers and comply with the housekeeping and good operating practices of 8-7. They will continue to be exempt from Phase II requirements under the revised Section 112.4.

  There is no technical reason preventing mobile refuelers from implementing these modest changes. Most facilities that operate mobile refuelers have already installed Phase I controls on their stationary storage tanks for receiving gasoline. Many mobile refuelers themselves are also already equipped with Phase I. Codifying these requirements will give District staff the regulatory tools to ensure that this vapor recovery equipment is installed and operated properly.

ADDITIONAL REVISIONS

In addition to the control strategies enumerated above, staff is proposing numerous other minor revision to Regulation 8-7. These changes are not expected to result in any significant emission reductions nor place any additional requirements on industry. However, they will help clarify the meaning and intent of the regulation, make it consistent with ARB requirements and other state law and improve its overall enforceability and effectiveness.

- **Reduced tank volume Phase I exemption** *(revised Section 8-7-111)*: The maximum volume of tanks exempt from Phase I requirements is being reduced from 260 gallons to 250 gallons to be consistent with H&SC 41950. Staff is not aware of any tanks which will be affected by this change.
- **Require Phase II equipment installed on Phase II exempt stations to be properly operated** *(revised Section 8-7-112)*: In some cases, a station with an improperly operated Phase II system can have higher emissions than a station with no Phase II vapor recovery at all, especially with the growing number of ORVR vehicles on the road. Although most stations who qualify for an exemption from Phase II requirements elect not to install a Phase II system, there are some stations eligible for an exemption who install Phase II anyway. Under the current regulation, District staff lacks the authority to require these stations to operate their Phase II equipment properly. This revision gives these stations the option of either operating their Phase II

controls in compliance with 8-7-302 or properly decommissioning them to prevent excess emissions.

- **Exempt marine vessels refueling from Phase II requirements** *(revised Section 8-7-112.6)*: These stations were previously exempted on the grounds that marine vessels are not included in the definition of motor vehicles. However, a new definition of motor vehicles (discussed below) is being proposed which would include boats and ships, hence the need for a specific exemption.

  Phase II vapor recovery is not considered technically feasible for marine vessels. Dispensers for refueling boats and ships are typically located on floating docks which rise and fall with the tide. This makes it difficult to maintain the vapor recovery piping at the necessary slope back to the storage tank to prevent liquid blockage. Dispensers are frequently located more than the normally accepted 100 foot maximum distance from the tanks for proper operation of a balance system. Long hoses are necessary to reach vessel fuel tanks. Vapor recovery is further confounded by the fact that many vessel tanks aren't equipped with fill necks. The combined effect of all these factors is to make it difficult, if not impossible, for Phase II vapor recovery to operate effectively. Not surprisingly, there are currently no certified Phase II systems for refueling boats and ships.

- **Exempt facilities refueling 90% ORVR vehicles from Phase II requirements** *(new Section 8-7-112.9):* Although ORVR-equipped vehicles will eventually eliminate the need for Phase II vapor recovery, non-ORVR vehicles are expected to account for a substantial portion of total vehicle miles traveled well into the next century. However, some vehicle fleets (such as car rental agencies) will reach near complete ORVR penetration far in advance of the general vehicle population. Continuing to require Phase II vapor recovery on stations serving these fleets makes little sense from either an economic or technical perspective. And, in the case of certain types of Phase II systems that are incompatible with ORVR, removing the Phase II system actually enhances vapor recovery by reducing tank vent and pressure-related fugitive emissions.

- **Expand definition of motor vehicles** *(proposed Section 216)*: The terms "vehicles" and "motor vehicles" are not defined in 8-7. This has led to requests for exemptions from vapor recovery requirements from stations which fuel vehicles not meeting the definition of "motor vehicle" in the California Motor Vehicle Code.

  Staff considers this to be a specious argument. Vapor recovery requirements should be based on technical and economic feasibility, not hair-splitting legalities. Staff does recognize that vapor recovery is not practical for "everything that moves." There are no certified Phase II systems for refueling aircraft, for example. However, any operation where Phase I or Phase II is clearly inappropriate should have no difficulty qualifying for an exemption from vapor recovery under Sections 8-7-111 and/or 112.

- **Other additional definitions** *(proposed Sections 8-7-210 through 222)*: Twelve additional definitions are proposed, most of which are commonly accepted terms in the petroleum marketing and/or vapor recovery industry. They are either being added to clarify existing and proposed requirements or address new technologies and methods that have been introduced since the regulation was last revised.

- **Expand operating instruction requirements to non-retail facilities** *(revised Section 8-7-307)*: With the increasing number of different vapor recovery systems installed in the Bay Area, it can no longer be assumed that everyone is familiar with the proper operation of all types of vapor recovery nozzles. Currently, signs are only required at retail stations.
- **Delete Section 8-7-310**: The original intent of this section was apparently to prevent some of the "non-technical" Phase II exemptions, such as those based on station throughput or vehicle tank size, from being used for tanks installed after March 4, 1987. However, the wording was unclear. The section could be interpreted as nullifying all the Phase II exemptions and requiring vapor recovery all tanks installed after March 4, 1987, even if Phase II was plainly inappropriate or not technically feasible.

  Section 8-7-310 is proposed for deletion. To retain the original intent of the section, the two "non-technical" Phase II exemptions (Sections 8-7-112.5, small vehicle tanks and 112.7, low throughput) are proposed to be amended to apply only to tanks installed before March 4, 1987. All other Phase II exemptions will be unaffected.
- **Add Hold Open Latch Requirement** *(proposed Section 8-7-314)*: Hold-open latches are mandated by state law. The proposed section incorporates the requirements of H&SC 41960.6. into Reg. 8-7.
- **Clarify Authority to Construct (A/C) requirements** *(revised Section 8-7-401)*: This proposed revision clarifies that an A/C is required for any GDF equipment replacement or modification where staff determines that a source test is necessary to demonstrate that the work was performed properly and the vapor recovery equipment operating in compliance with District Regulations and any applicable CARB requirements. This is a codification of existing District policy.
- **Mandate testing requirements for all stations** *(proposed Section 8-7-406)*: All GDF A/Cs include conditions requiring the station to perform one or more source tests upon project completion to verify that the equipment is operating in compliance with District and CARB requirements. However, it is not unusual for stations to complete a project without obtaining an A/C. These stations are then often reluctant to perform the tests or unable to locate results because of the length of time that has elapsed since project completion. Currently, the District lacks direct authority to take action on the basis of non-submittal of tests; stations can only be cited for operating without a permit.

  The proposed language will clarify that testing is required regardless of whether an A/C was obtained prior to construction and provide a clear and firm basis for denying permits and taking enforcement action against such stations which are recalcitrant about performing the tests or providing the results to the District.
- **Introduce record keeping requirements for all stations:** *(proposed Section 8-7-503)*: Most stations are already required to keep records of their throughput via permit conditions; the proposal will extend this requirement to all stations. Compliance with this requirement should not be much of a burden, as all GDFs must already maintain detailed throughput records for tax purposes

EMISSION CALCULATIONS

Basic Assumptions

Implementation of several of the proposed amendments to Reg. 8-7 will result in quantifiable emission reductions from the affected stations. To estimate the total emission reductions, staff estimated the total number of stations subject to the various control measures based on appropriately adjusted data in the District's data bank.

The District does not have current data on the amount of gasoline pumped by individual GDFs. In lieu of exact numbers, annual gasoline throughput for retail stations was estimated at 90,000 gallons per nozzle. This is based on the District-wide average. Throughput for non-retail facilities was estimated at 7.6 times total tankage volume. This factor was generated from a linear regression analysis of throughput data vs. total tank capacity for a sample of 30 non-retail stations chosen at random from the Districts files. Total throughput was then multiplied by appropriate emission factors to determine the total emission reduction. A detailed spreadsheet of the emission calculations appears in the Appendix.

All emission factors for abated and unabated emissions were taken from Appendix A of the 1997 "CAPCOA Gasoline Service Station Industrywide Risk Assessment Guidelines."

Calculations

Increase Phase I vapor recovery efficiency to 98%

Assumptions: Emission reductions will occur at all stations equipped with Phase I equipment

Stations affected: 2471 (1631 retail, 840 non-retail, from BAAQMD records)
Estimated throughput: 3.070 x 10^6 Mgal/yr.
Emission factor: (8.4 # VOC/Mgal) (3% efficiency increase) = 0.25 #/Mgal

<u>Emission reduction: 386.9 tpy</u>

Prohibit Coaxial Phase I systems

Assumptions: Current coaxial Phase I systems are only 70% effective[7]
All stations equipped with coaxial Phase I will convert to two point

Stations affected: 674 (270 retail, 404 non-retail, from BAAQMD records)
Estimated throughput: 3.429 x 10^5 Mgal/yr.
Emission factor: (8.4 # VOC/Mgal) (25% efficiency increase) = 2.1 #/Mgal

<u>Emission reduction: 360.0 tpy</u>

Prohibit Remote Vapor Check Valves

[7] BAAQMD Clean Air Plan

Assumptions: Evaporation due to remote vapor check valves lowers Phase II efficiency by 11.3%[8]

Stations affected: 529 (401 retail, 128 non-retail, from BAAQMD records)
Estimated throughput: 5.788 x 10^5 Mgal/yr.
Emission factor (8.4 # VOC/Mgal) (11.3% efficiency increase) = .95 #/Mgal

Emission reduction: 274.7 tpy

Prohibit Dual Hose Nozzles

Stations affected: 33 (estimated @ 2% of balance stations)
Estimated throughput: 1.64 x 10^4 Mgal/yr.
Emission factor: (8.4 # VOC/Mgal) (4% efficiency increase) = 0.34 #/Mgal

Emission reduction: 5.5 tpy

Require PV Valves on Phase I Exempt Stations

Stations affected: 67 (10 retail, 57 non-retail, from BAAQMD records)
Estimated throughput: 3.50 x 10^3 Mgal/yr.
Emission factor: 1.16 #/Mgal

Emission reduction: 2.0 tpy

Require Phase I on mobile refueling operations

Stations affected: 31 (estimated at 6 aviation, 25 miscellaneous)
Estimated throughput: 9.50 x 10^3 Mgal/yr.
Emission factor: (8.4 # VOC/Mgal) (95% efficiency) = 7.98 #/Mgal

Emission reduction: 37.9 tpy

Revise Phase II certification standards

Assumptions: Emission reductions will only occur at stations currently operating vacuum assist Phase II
Vacuum assist stations are currently emitting 3.5 #/Mgal[9] above the new certification levels
All stations will eventually convert to Phase II systems meeting the new standards

Stations affected: 583 (from BAAQMD records; all are retail stations)
Estimated throughput: 1.32 x 10^6 Mgal/yr.
Emission factor: 3.5 #/Mgal

Emission reduction: 2304.7 tpy

Establish minimum diameter on Phase II riser coupler

Assumptions: Sub-standard couplers reduce Phase II vapor recovery by 1%

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[8] BAAQMD Clean Air Plan
[9] Ibid.

Stations affected: 909 (737 retail, 172 non-retail, estimated at 75% of retail and 25% of non-retail sites with balance Phase II)
Estimated throughput: 1.65×10^6 Mgal/yr.
Emission factor: (8.4 # VOC/Mgal) (1% efficiency) = .084 #/Mgal

<u>Emission reduction: 7.1 tpy</u>

TOTAL EMISSION REDUCTIONS = 3,378.8 tons per year
= 9.26 tons per day

COST OF CONTROL

The costs of several of the proposed control measures are expected to be zero. These proposals only prohibit installation of certain vapor recovery components and systems at new or modified stations. Stations would be allowed to continue to operate existing equipment for the remainder of its useful life. The cost differential between the complying and non-complying equipment is negligible; in some cases, the compliant equipment is cheaper. Installation costs are expected to be identical. No additional installation costs would be incurred because only worn out components would be replaced. None of these costs are attributable to the control measures. These measures are as follows:

Increase Phase I vapor recovery efficiency to 98%

This requirement can be satisfied by proper operation and maintenance of existing two-point systems. No additional expenditures required.

Prohibit Coaxial Phase I systems

The equipment and installation cost for two-point system and coaxial systems on a new or modified tank is essentially the same.

Revise Phase II certification standards

Re-certifying Phase II systems to emission-based standards will not entail any additional costs for existing stations, and should not have a significant effect on the price of new equipment. Staff anticipates than many Phase II systems will be certified to the new standards without any significant changes in design or specification.

Prohibit new non-ORVR compatible vacuum assist systems

Currently, only one vacuum assist Phase II system (Healy) has been certified by CARB as ORVR-compatible. As the Healy system is not the most inexpensive vacuum assist system, this measure will increase the costs for stations who wish to convert to vacuum assist. However, Reg. 8-7 does not specifically require vacuum assist. Phase II requirements can also be satisfied by balance systems, which are less expensive than any vacuum assist system. As the decision to install the more expensive vacuum assist systems is discretionary, no increased costs are associated with this proposal.

Several of the proposed amendments will require the modification and/or replacement of in-service equipment. For the purposes of this analysis, total component and installation costs were amortized over five years using a 10% capital recovery factor. This is a worst case analysis. It neglects the fact that many of these components have a limited service life and are periodically replaced. Actual cost of the control measure for a station with components near the end of their useful life would only be the difference in capital cost between complying and non-complying components. This increment is typically small. The actual cost-effectiveness of these measures for many stations will be considerably greater than the values calculated below.

Labor costs are estimated at $45 per hour.

Prohibit Remote Vapor Check Valves

Assumptions: Nozzle cost: $170 each
Labor: 3 hours for retail stations, 1 hour for non-retail
Stations affected: 529 (401 retail, 128 non-retail, from BAAQMD records)
Total cost of measure: $1,181,000.

<u>Cost/ton Emission reduction: $1,134/ton</u>

Replace Dual Hose Nozzles with coaxial models

Assumptions: Nozzle, hose, and splitter cost: $395
Labor: 3 hours for retail stations, 1 hour for non-retail
Stations affected: 33 (estimated @ 2% of balance stations)
Total cost of measure: $158,000.

<u>Cost/ton Emission reduction: $7,586/ton</u>

Require PV Valves on Phase I Exempt Stations

Assumptions: PV valve: $60 each; three per retail station, one per non-retail
Labor: 1 hour
Stations affected: 67 (10 retail, 57 non-retail, from BAAQMD records)
Total cost of measure: $8,200

<u>Cost/ton Emission reduction: $1,086/ton</u>

Install Phase I on mobile refueling operations

Assumptions: Parts for tank and truck: $2,900
Labor: 6 hours
Stations affected: 31 (estimated at 6 aviation, 25 miscellaneous)
Total cost of measure: $98,300

<u>Cost/ton Emission reduction: $684/ton</u>

Replace undersized Phase II riser couplers

Assumptions: Coupler cost: $40 (six per retail station, one per non-retail station)
Labor: 3 hours retail, .5 hours non-retail

Stations affected: 909 (737 retail, 172 non-retail, estimated at 75% of retail and 25% of non-retail sites with balance Phase II)
Total cost of measure: $286,000

Cost/ton Emission reduction: $10,640/ton

TOTAL COST OF CONTROLS = $1,732,000

= $5,292/TON emission reduction

ADVERSE IMPACTS

Staff has been unable to identify any significant adverse environmental or health impacts associated with these proposed amendments. There should be no increase in water pollution or solid waste generation. Traffic and fuel consumption should remain unchanged. No new air pollutants will be emitted, and the composition of existing emissions should remain unchanged. Total emissions of both criteria pollutants (precursor organics) and toxic air contaminants (primarily benzene) from this source category should decrease. Staff will be completing a CEQA initial study to fully asses the environmental impacts.

The only impact of potential significance is economic. It may cost some stations up to $10,000 to come into compliance with the new requirements. Although this is not insignificant, it should be noted that costs of this magnitude will only be incurred at a small number of stations operating outdated, obsolete equipment such as dual-hose nozzles and remote vapor check valves. The overwhelming majority of stations replaced these components many years ago. In fact, it could be argued that at least a portion of the cost of these modifications should be considered deferred maintenance and not attributed to the control measures. Staff does not expect any financially viable station to close as a result of these amendments. A more detailed socioeconomic study will also be performed to determine the impact of the measure on Bay Area businesses as part of the final staff report.

For most stations, the cost of compliance will be well under $1,000. Staff expects that many stations are already in full compliance with the proposed amendments and will experience zero costs.

The proposed amendments may also limit the number of types of Phase II systems that may be installed. This should not place any operational or economic burdens on the industry, as the balance system, the cheapest and most widely used Phase II system in the District, will continue to be allowed.

CEQA

Pursuant to California Environmental Quality Act Guidelines section 15168, this rule is found to be within the scope of the project covered by the Final Environmental Impact Report (EIR) for the Bay Area [year] Clean Air Plan, which was approved by the District Board on [date]. This EIR adequately describes the activity for the purposes of CEQA, and no new environmental document is necessary. Potential environmental impacts are summarized and discussed in the attached Initial Study.

CONCLUSION

This control measure is feasible in the Bay Area and can be enacted readily. Since the EPA has redesignated the Bay Area as an ozone nonattainment area, the District must achieve new emission reductions. This measure presents an opportunity to not only reduce emissions from this source category, but to forestall potential future emissions increases. The proposed revisions to Regulation 8, Rule 7, Gasoline Dispensing Facilities, will also clarify existing language and improve the enforceability of the regulation as well as partially satisfy the requirement in the Clean Air Plan for the adoption of control measure B8.